THE PLANT GROWTH SIMULATOR

Teacher's Lesson Planner

Elementary Version

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Teacher's Lesson Planner

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About This Manual

This Teacher's Lesson Planner describes the objectives of *The Plant Growth Simulator: Elementary Version* programs and the most effective ways to use the diskettes. In the margins, you will find phrases to help you locate information quickly and pertinent notes to remind you of important features. This manual also suggests some strategies for incorporating the programs into your lessons, and includes the answer keys to the worksheets found in the Student Workbook, which is an integral part of your *Plant Growth Simulator* package.

The Student Workbook includes instructions for using the programs and a series of worksheets that guides students to record observations at each step of the work that you present or assign. See the section called "About the Student Workbook" on page 22 for more specific information. Student Workbooks are available in class sets.

If you have problems getting the program to run, and have checked to see that other programs run on your machine, or if you believe you have received defective disks, please contact us toll free at (800) 645-8989, (516) 794-8900 in New York State. Our customer service representatives will be happy to help you. Please have your invoice number handy when you call.

Focus Media warrants all disks to be free of defects for a period of 90 days from date of purchase. After that period, disks may be replaced at a charge of $10 per program. Please note that Focus Media disks are copy protected, and therefore cannot be duplicated.

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Introduction

Let's assume that you wanted to provide your class with a complete study of plant growth on an elementary level—not just by discussing it, but by really SHOWING it happening! How would you do it?

You'd probably want to demonstrate various types of plant pollination and fertilization. You'd show your students how a fruit forms from a flower, how seeds are spread, and how plants germinate and grow into new plants, or for that matter, how plants can grow without seeds. In addition, you would probably want to show how plants can respond to light, touch, gravity, and water.

You can well imagine the difficulty of demonstrating all of these processes successfully and effectively; at least that was true until now! By means of a computer simulation, such demonstration are simple. *The Plant Growth Simulator: Elementary Version* makes the study of these plant processes as comprehensible as it would be if live plants were used.

With the help of very colorful animated sequences, you will be able to show your students processes that normally occur underground, in very small parts of plants, or over very long periods. Let them watch a bee pick up pollen from one flower and deposit it onto another; show them how a flower develops into a fruit; let them see how a dandelion spreads its parachute-like seeds or how a bean seed germinates and grows into a full plant; demonstrate how plants grow towards light; have them experience the growth of a strawberry plant from runners.

Students often have a great deal of difficulty in picturing the processes that occur during the reproduction and growth of plants. Although textbook pictures and diagrams are helpful, they generally fall short of capturing the dynamics of processes involved in plant growth. Although video or film can demonstrate the dynamics of plant growth, they do not provide the degrees of interaction or control possible with these computer simulations.

This Teacher's Lesson Planner is designed to enhance your use of the programs on these disks. We have spelled out how best to utilize each of the many simulations in our section entitled "Program Description" on page 4. This will allow you to preview the program without even booting up (starting) the disk. Actually, the programs are so simple to use that this section is only needed to help you to learn more about each simulation. The "Strategies for Classroom Use" section on page 18 is designed to provide you with ideas for integrating the programs into your curriculum. Of course, they only provide "seeds" for your own ideas.

Included in your *Plant Growth Simulator* package is a Student Workbook. The Student Workbook consists of two kinds of worksheets. The first series of worksheets, 1-8, contain questions that your students can answer while using the programs. They are designed to encourage active viewing of the various simulations as well as comprehension of the text screens. The remaining worksheets provide your students with follow-up activities and should be done away from the computer, either at their seats or for homework. See the section called "About the Student Workbook" on page 22 for more information.

Educational Objectives

- To provide students with a basic understanding of essential life functions through the study of plants.

- To allow students to see how plants adapt to their environment.

- To enable students to visualize various processes in plants with the help of computerized animations.

- To help students understand the various ways in which pollination can be facilitated in flowers.

- To provide students with a basic understanding of the process of fertilization in plants.

- To demonstrate to students how fruit formation occurs from a flower.

- To allow students to understand how seeds are spread in various types of plants.

- To help students understand the process of germination in both monocot and dicot plants.

- To enable students to see how plants respond to light, touch, gravity, and water.

- To provide students with a visual simulation of how plants can reproduce without seeds.

- To help students to see how flowering plants are complex organisms having many specialized parts.

Program Description

The Plant Growth Simulator consists of two double-sided diskettes. Disk One, Side One consists of ten separate simulations involving pollination and fertilization. Side Two consists of six programs that simulate fruit formation and spreading of seeds. The second disk also contains two sides. Side One contains seven programs that simulate plant growth and various kinds of tropisms. The second side of Disk Two contains four programs that simulate how plants can grow without seeds, and a review and quiz of flower parts.

When any side of either diskette is booted up (started), a title screen appears. Programs are accessed from the menus that follow the title screens. Each of the programs is listed below. All programs are summarized beginning on page 7 of this manual.

Disk One, Side One

1. Pollination
   - A. Wind Pollination
   - B. Insect Pollination: Pick up Pollen
   - C. Insect Pollination: Leave Pollen
   - D. Self-Pollination
   - E. Cross-Pollination
   - F. All of the Above

2. Fertilization

Disk One, Side Two

3. Fruit Formation

4. Spreading Seeds
   - A. Dandelion
   - B. Flying Bird
   - C. Maple Wings
   - D. Coconut
   - E. Touch-Me-Not
   - F. All of the Above

Disk Two, Side One

1. Plant Growth
   - A. Germination
   - B. Bean Plant: Dicot
   - C. Corn Plant: Monocot

2. How Plants Respond
   - A. Plants Respond to Light
   - B. Plants Respond to Touch
   - C. Plants Respond to Gravity
   - D. Plants Respond to Water

Disk Two, Side Two

3. Growing Plants Without Seeds
   - A. Runners
   - B. Rhizomes
   - C. Bulbs
   - D. Tubers
   - E. All of the Above

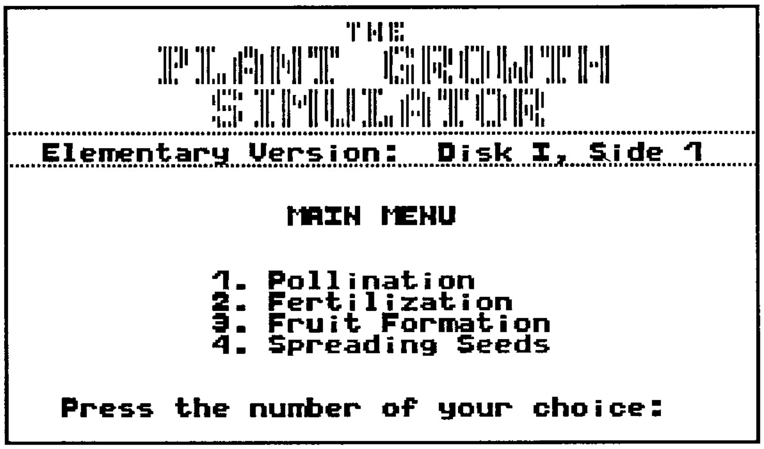
4. Parts of the Flower
   - A. Parts of the Flower
   - B. Parts Quiz

Throughout the programs of *The Plant Growth Simulator,* the keys that can or must be pressed in order to advance are always indicated on the screen at the appropriate time. They are as follows:

ESC — returns the user to the previous menu
S — allows the user to observe the simulation in sequences of one picture at a time
M — provides the user with a completely animated simulation

In addition, *The Plant Growth Simulator* provides you with optional text. You will be asked when you first load the disk, whether or not you would like this option. Your answer will simply depend on your purpose in using the program. The section of this Teacher's Lesson Planner entitled "Strategies for Classroom Use" will help you to decide (see page 18).

When any side of *The Plant Growth Simulator* is booted up, the title screen appears and is followed by one of the menu screens below:

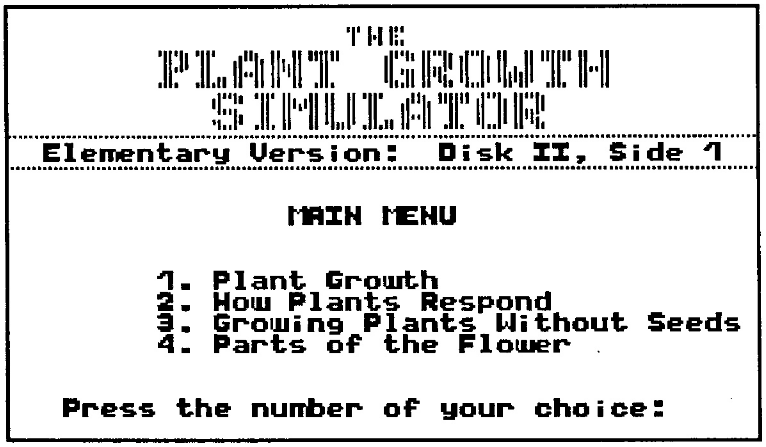


```
                 THE
        PLANT GROWTH
          SIMULATOR
Elementary Version:  Disk I, Side 1

              MAIN MENU

         1. Pollination
         2. Fertilization
         3. Fruit Formation
         4. Spreading Seeds

  Press the number of your choice:
```



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                 THE
        PLANT GROWTH
          SIMULATOR
Elementary Version:  Disk II, Side 1

              MAIN MENU

      1. Plant Growth
      2. How Plants Respond
      3. Growing Plants Without Seeds
      4. Parts of the Flower

  Press the number of your choice:
```

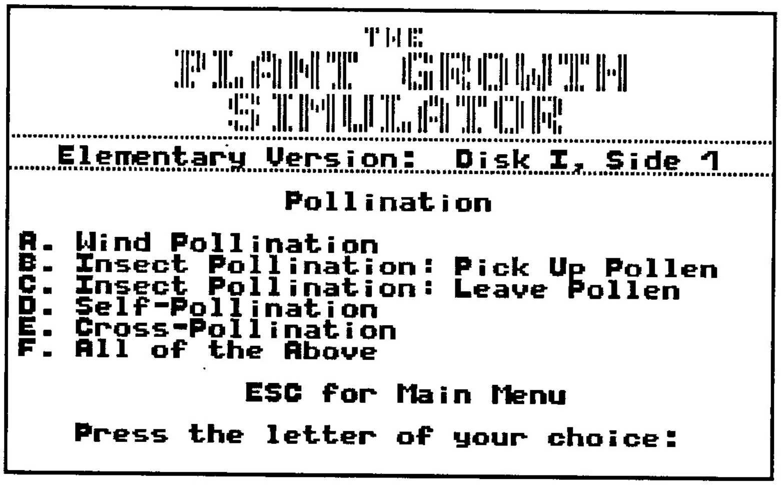
All programs on the diskette are easy to access. To choose a program, simply type the letter or number next to its name. If you wish to view a program on the opposite side of the diskette, turn the diskette over while the program is on the screen and press ESCAPE to reach the menu.

Although the programs are summarized on the following pages in the order in which they appear on the respective menus, you are not bound to follow this sequence when you use them.

Disk One, Side One

1. Pollination

When you select menu option 1: Pollination, the submenu below appears on the screen. The various processes that plants use for pollination are illustrated in five simulations. Each may be viewed individually by pressing the appropriate letter, or as a complete sequence by pressing the "F" key when the Pollination Menu appears on the screen.



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                 THE
        PLANT GROWTH
          SIMULATOR
 Elementary Version:  Disk I, Side 1
             Pollination

A. Wind Pollination
B. Insect Pollination: Pick Up Pollen
C. Insect Pollination: Leave Pollen
D. Self-Pollination
E. Cross-Pollination
F. All of the Above

           ESC for Main Menu

   Press the letter of your choice:
```

A. Wind Pollination—This program shows how pollen may be transferred to the flowers of a plant by the wind. The tiny pollen grains are carried by the wind or air currents from the right side of the screen to the flower on the left side. Some, but not all, of the pollen adheres to the flowers.

B. Insect Pollination: Pick Up Pollen—The purpose of this program is to illustrate how insects may unknowingly assist plants in pollination. As an insect (in this simulation, a bee) lands on the petals of a flower, the flower's stamen brushes against the back of the bee. The pollen sticks to the insect and when it flies away, some pollen is removed from the plant.

C. Insect Pollination: Leave Pollen—As some insects travel from flower to flower, they often carry pollen on their bodies and unknowingly pollinate flowers. This program shows how this might be done. An insect (again a bee) carrying pollen is attracted to the colorful petals of the flower of a plant. As the bee lands and searches for food, the pollen on its back is deposited on the stigma of the flower's pistil.

D. Self-Pollination—This simulation illustrates one way in which self-pollination may take place. The grains of pollen from one flower of a plant fall onto a lower flower of the same plant. Some of the pollen sticks to the lower flower. In this way the plant is able to reproduce successfully.

E. Cross-Pollination—This program illustrates that in some plants the pollen needed for pollination is obtained from a different plant of the same species. Pollen from the plant appearing on the left is transferred to the plant on the right by wind or air currents. When the pollen reaches the plant on the right, some of the material sticks to the flowers, leading to cross-pollination.

2. Fertilization

This simulation shows the fertilization of a flower's egg by sperm. A combination of full views and close-up views brings out the details involved in the fusion of the male and female nuclei.

Pollen grains may contain many sperm nuclei; three are illustrated in the simulation. After the pollen sticks to the pistil, the first nucleus forms the pollen tube by dissolving the material of the pistil. The two additional nuclei move along the tube towards the ovary. When the tube reaches the ovary (the program shows a detailed enlargement), the sperm nuclei enter the ovule. The nucleus that formed the pollen tube disintegrates. The two remaining nuclei unite with egg nuclei in the ovule and complete fertilization.

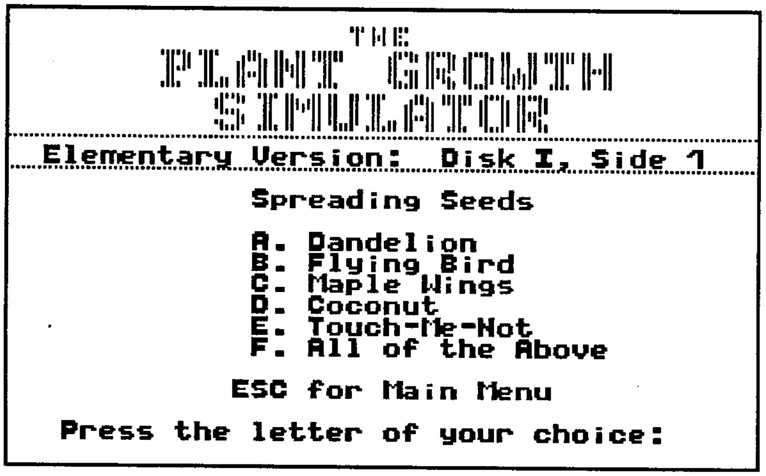
Disk One, Side Two

3. Fruit Formation

The Fruit Formation simulation illustrates how the withering of a flower followed by the development of fruit may be very attractive to animals such as birds. The simulation begins with a view of a cross-section of a flower that has been pollinated. The pollen tube is clearly illustrated in the early screens. Following fertilization, the flower petals wither and die. The fruit and seed form and develop from the walls of the ovary. The sequence continues by showing the fruit (a cherry) in full view. The cherry ripens and is finally picked by a very colorful bird.

4. Spreading Seeds

After you select menu option 4: Spreading of Seeds, the submenu shown below will appear. There are five different methods illustrated by individual simulations. Select the letter of the particular simulation you wish to view. They may be accessed in any order.



THE
PLANT GROWTH
SIMULATOR

Elementary Version: Disk I, Side 1

Spreading Seeds

A. Dandelion
B. Flying Bird
C. Maple Wings
D. Coconut
E. Touch-Me-Not
F. All of the Above

ESC for Main Menu

Press the letter of your choice:

A. Dandelion—The seeds of plants are often designed to be transported away from the competition of parent plants. This simulation uses the dandelion to illustrate this concept. The seeds of dandelions are dispersed by the wind. The tops of the seeds are shaped like parachutes. Air currents lift and remove the seeds, carrying them away from competition with the parent plant. Strong winds can carry the seeds great distances.

B. Flying Bird—The purpose of this simulation is to show one way that animals help to disperse plant seeds. A bird appears in a tree. As the bird flies away, it carries fruit in its mouth. Some distance from the tree, the fruit falls from the bird's mouth and lands on the ground.

C. Maple Wings—This simulation shows that the shape of the maple seed (winged) aids in its dispersal. Two views of the falling seed appear on the screen. The box on the left shows the full view of the seed falling from a tree. The right side of the screen shows a detailed view of the same maple wing. The winged shape of the seed causes it to spin and fall away from the parent tree.

D. Coconut—This simulation illustrates that some plants on islands form seeds that are carried to other locations by water. The coconut is just such a plant by virtue of its ability to float in water. In this simulation, a coconut falls from a tree, after which the tide lifts and carries the coconut across the water to another island, or another portion of the same island, where competition with established plants is not as great.

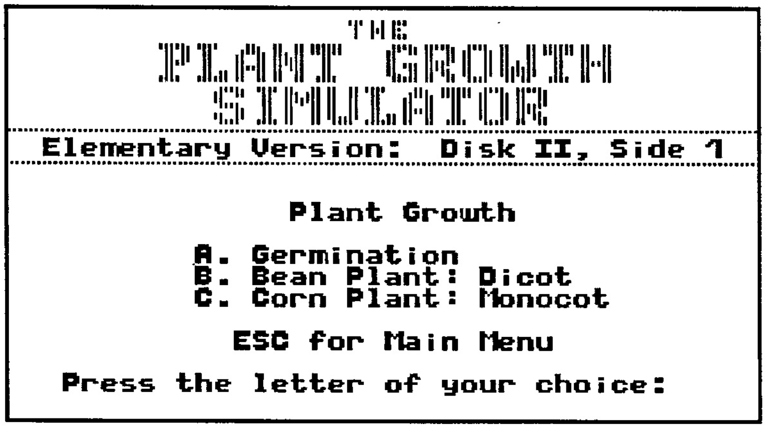
E. Touch-Me-Not—Several plants develop fruit that burst open as they mature. The rapid opening of the fruit propels the seeds away from the parent plant.

The fruit of a developing touch-me-not swells as it reaches maturity. The seed pod eventually bursts (sometimes seed pods burst after being touched by animals). The seeds are propelled out of the pod and fall some distance from the parent plant.

Disk Two, Side One

1. Plant Growth

When you select menu option 1: Plant Growth, the submenu shown below appears:



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                    THE
          PLANT GROWTH
             SIMULATOR
Elementary Version:  Disk II, Side 1

             Plant Growth

        A. Germination
        B. Bean Plant: Dicot
        C. Corn Plant: Monocot

          ESC for Main Menu

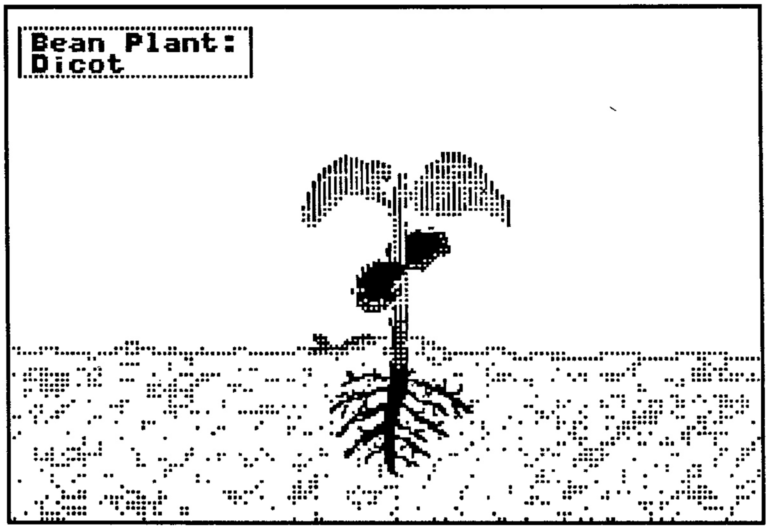
    Press the letter of your choice:
```

This section of *The Plant Growth Simulator* introduces the viewer to seed germination and the growth and development of both monocot and dicot plants.

A. Germination—This simulation demonstrates some conditions needed for plant seeds to germinate. The loosely-packed soil contains the air with its oxygen, and the moisture is provided by rain.

The plant seeds become covered by loose soil. The falling rain provides the moisture needed for the seeds to germinate. As the seeds germinate, the early root grows and later will anchor the plant. The early stem begins to form and grow upwards.

B. Bean Plant: Dicot—This program simulates the germination and growth of a bean plant (a dicot). As the plant develops, the two seed leaves (cotyledons) become clearly visible.

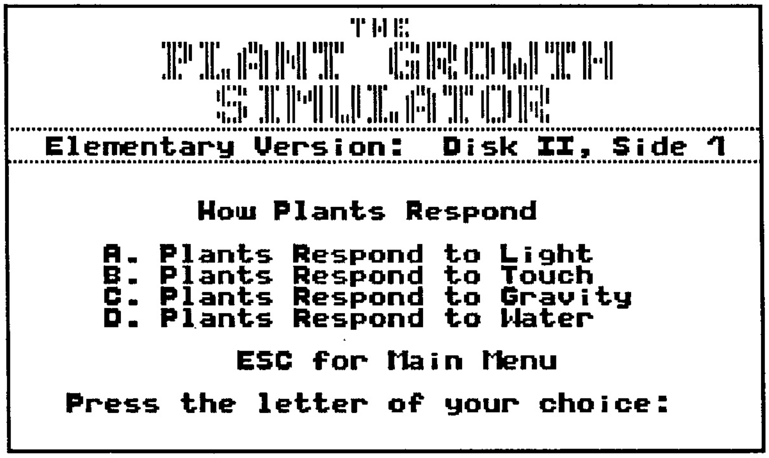


The seed of the bean plant germinates and the root grows downward, anchoring the plant. After the plant is anchored, the stem begins to grow. As the stem grows upward, it passes through the surface of the soil. The two cotyledons spread out. These seed leaves provide food for the young plant until the first true leaves develop. The cotyledons then shrivel and fall off the plant.

C. Corn Plant: Monocot—This simulation demonstrates the germination and development of a corn seed (a monocot). The germination of the corn plant first becomes apparent as the root grows from the seed. Once the root has anchored the plant, the stem begins to grow towards the surface of the soil. The shoot-like stem develops the bladed leaves common to most, but not all, monocots. The coconuts used in an earlier simulation are monocots whose leaves do not appear bladed.

When you select menu option 2: How Plants Respond, the submenu shown below appears:

2. How Plants Respond


THE
PLANT GROWTH
SIMULATOR

Elementary Version: Disk II, Side 1

How Plants Respond

A. Plants Respond to Light
B. Plants Respond to Touch
C. Plants Respond to Gravity
D. Plants Respond to Water

ESC for Main Menu

Press the letter of your choice:

Tropism, the reaction of plants to various environmental stimuli, is illustrated in this series of programs.

A. Plants Respond to Light—As they grow, plants respond to light sources. In this simulation two light bulbs are used to demonstrate phototropism in plants. The initial screen shows the plant and the two light sources; one light bulb is on the left and the other is on the right. When the right bulb is turned on, the plant responds by growing toward the light, a positive phototropism. After several growth scenes, the right bulb shuts off, and the left bulb lights up. The plant now responds by growing toward the left, toward the new source of light.

B. Plants Respond to Touch—The purpose of this simulation is to demonstrate the response of some plants to touch, (thigmotropism). As the plant grows, it touches and wraps itself around a pole. This type of positive response is typified by ivy clinging to a building's walls.

C. Plants Respond to Gravity—*The Plant Growth Simulator* presents two examples of geotropism.

(1) Falling Plant—This simulation shows that the stem of a plant will grow away from the force of gravity. After a potted plant falls over, it begins to bend as it grows. The stem turns or bends away from the ground as a negative response to the pull of gravity. This upward growth of plant stems is the result of a negative geotropism.

(2) Mountainside—Plants on the sides of mountains often grow in unusual shapes as a result of geotropism. This simulation shows the responses of both the roots and stem of a plant growing on a mountainside.

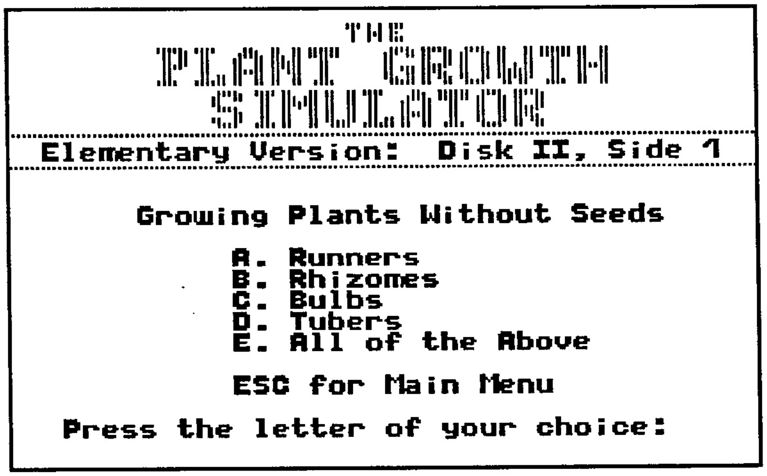
A plant is isolated in a highlighted box. As the plant develops, the roots grow downward as a result of a positive geotropism. At the same time, there is an upward bending of the stem as a result of a negative geotropism. The stem grows against the pull of gravity.

D. Plants Respond to Water—Hydrotropism, the growth response to water, is illustrated by a simulation of a plant and a water faucet. Plant roots grow toward the moisture in the soil. As the water from the faucet infiltrates the soil, the plant roots on the side nearer to the water grow faster than the roots on the other side of the plant. This growth is the result of a positive hydrotropism.

Disk Two, Side Two

3. Growing Plants Without Seeds

When the third menu option is selected, the Growing Plants Without Seeds submenu will appear on the screen.



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                    THE
          PLANT GROWTH
             SIMULATOR
 Elementary Version:  Disk II, Side 1

       Growing Plants Without Seeds

             A. Runners
             B. Rhizomes
             C. Bulbs
             D. Tubers
             E. All of the Above

             ESC for Main Menu

     Press the letter of your choice:
```

This section of *The Plant Growth Simulator* demonstrates several examples of what is often called vegetative propagation. It may be viewed in its entirety, or as a series of individual simulations.

A. Runners—Some plants, such as strawberries, develop modified stems or runners. A runner is a stem that grows out of the roots of a plant. When a bud on the runner touches the soil, it becomes anchored by roots and gives rise to a new plant.

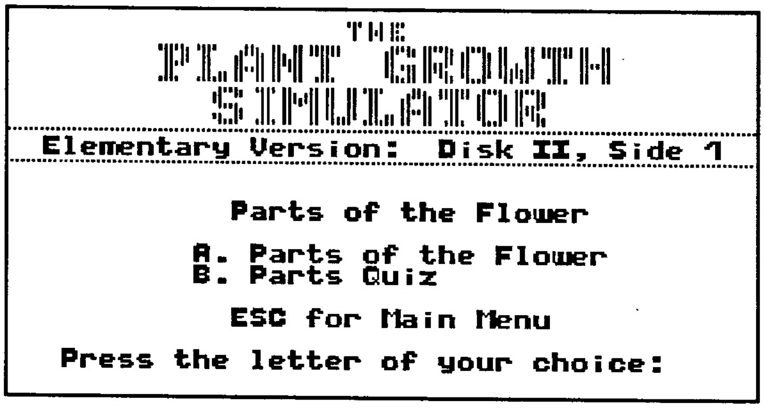
B. Rhizomes—The growth of new plants from rhizomes is an important form of vegetative propagation. The new flowers of an iris plant develop from the new rhizomes that form from the parent plant. These plants are very difficult to develop from seeds. As the rhizome grows, new leaves may grow upward while new roots grow down. The young plants develop from the new shoots and roots of the older rhizome.

C. Bulbs—The purpose of this simulation is to show how plants can grow from thickened storage leaves called bulbs. As the plant develops, new bulbs form from the original plant. Each of these new bulbs can grow into a new plant. In this simulation, an onion develops.

D. Tubers—Enlarged storage stems are called tubers. As the plant grows, it forms new tubers at the end of its roots. New plants may be grown from the buds found on tubers. The stored food will provide nourishment for the new plant, in this case, a potato plant.

4. Parts of the Flower

This program is intended for the student who is unfamiliar with the names or functions of the parts of the typical flower, or for the teacher who is introducing students to flowers for the first time. When this program is chosen, the submenu shown below appears on the screen.



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                    THE
          PLANT GROWTH
            SIMULATOR
Elementary Version:  Disk II, Side 1

          Parts of the Flower

        A. Parts of the Flower
        B. Parts Quiz

          ESC for Main Menu

   Press the letter of your choice:
```

A. Parts of the Flower—This program allows students to learn the parts of a flower and their functions. Students move the box by pressing the space bar until the part to be described is outlined. A brief description of each part will appear as the highlighting box outlines the section of the flower. They can describe each part as often as they wish. The parts identified in the program are: stigma, style, ovary, ovules, sepals, anther, filament, and petal.

B. Parts Quiz—The object of the quiz is to see how well students have learned the material in "Parts of the Flower," above. In "Parts Quiz," students match the highlighted part of a typical flower and definition to the name given at the upper left. They press the space bar to move a highlighting box around the flower until the part outlined and described is the part named. They then press the RETURN key. If they press the RETURN key while an incorrect part is highlighted and described, they are so informed and given a second opportunity to identify the given part. If they answer incorrectly again they will be given a third and fourth opportunity. After the fourth incorrect response they are given the correct answer. The parts included in this program are the same as those included in the "Parts of the Flower" program.

Strategies for Classroom Use

This program is designed to be integrated into your normal teaching of the topic of plant growth. As simply one aspect of this topic, it should be used together with text or workbook readings, class discussions, written work, and class experiments.

Generally, your students will have a limited amount of time to spend at the computer. As a result, this program is designed to be used in one of two ways:

1. As a classroom demonstration with one computer in front of the classroom.

2. As a means of study for individuals or small groups.

With one computer in front of your classroom, the program will provide hours of lessons about plant growth. Of course, the larger the monitor the better; however, use of a smaller monitor can be effective. Just gather your entire class around the screen and pick student volunteers to press the appropriate keys to work the program.

Whenever you find it appropriate to use the text mode, we suggest that you use it by allowing student volunteers to read the screen preceding each simulation to the entire class. Students can bring their workbooks or worksheets with them and write in answers as the simulations are progressing. See the section called "About the Student Workbook" on page 22 for a listing of worksheets.

If possible in your school, look into hooking up several monitors to one computer. Then place the monitors in strategic locations in your classroom. In this way, students can sit in their normal seats while the lesson is going on.

If you prefer not to present the simulations to the entire class at the same time, you can schedule one or several students at a time at the computer. If you do this, we suggest that you assign no more than one side of a disk at a time for scheduling purposes. Have students bring their workbooks to the computer since Worksheets 1-8 are designed to be filled out while observing the program.

If you are fortunate enough to have a computer lab available, you may have the entire class work through the various simulations at their own pace. Alternatively, you can gear the presentation to the class as a whole.

The following are some specific suggestions for conducting classroom experiments to enhance your use of the programs:

1. Have students bring various types of fruit to class. Let them compare common elements in and differences among the types. If it is the appropriate season, you might even have them bring in fruit blossoms. Discuss the development of blossoms into fruit.

2. Let students plan and carry out experiments related to proper conditions for plant growth. For example, they can vary the temperature, the water content of the soil, and the air.

Bean seeds are good to use for such an experiment. One way of reducing the amount of air is to burn a match or wooden splint in a jar. This removes most of the oxygen. Then grow the bean seed in this jar.

3. Help students to observe how roots grow with this simple activity. Ask students to bring in (or provide them with) an onion or a sweet potato. Have them fill a glass jar with tap water to within about an inch from the top, to insert four toothpicks around the center of either the onion or sweet potato and to place it into the jar (root side down for the onion; pointed side down for the sweet potato). Have them place the jars in front of a sunny window and check them every day (keeping notes on their observations). Remind them to keep the jars filled with water.

4. Have students plant seeds from edible fruit. Good examples include: apple, melon, orange or grapefruit, or tomato. Let them keep notes, including features that identify the plant as monocot or dicot.

5. Have students each bring in at least one type of flower, either from their garden or a florist. Then, put on the program from *The Plant Growth Simulator* entitled "Parts of the Flower." As each flower part is brought up on the screen, have students locate corresponding flower parts on their flowers.

6. Ask students to bring in a small potted plant to observe phototropism. Have them place the plants in a sunny location, give them the necessary care, but avoid turning the plants from their original position. Direct students to note when their plants are obviously growing towards the light. This is a long-term experiment.

Follow-up Activities

Worksheets 9-13 contain activities that can be assigned as class work or homework after students have finished using *The Plant Growth Simulator*. In addition, the following assignments are reproduced from Worksheet 14, and can be used as creative writing activities. As an optional activity, have students illustrate their work.

1. Pretend you are a bee. Write about what it is like to move from flower to flower. How does it feel to know that you are helping plant pollination?

2. Pretend that you are a grain of pollen that has just landed on a flower. Describe what happens to you while you form a seed through fertilization.

3. Pretend that you are a dandelion. Describe what happens to you as you grow. How do you spread your seeds?

4. Pretend that you are a plant seed. What needs to happen for you to grow in the right way?

5. Pretend that you are a plant near a window. What does it feel like to grow towards the light?

6. Pretend that you are a tulip bulb. Describe what happens to you as you are planted. What does it feel like to grow into a tulip?

About the Student Workbook

The Student Workbook may be ordered in class sets, and it contains the following:

1. An introduction to *The Plant Growth Simulator*
2. A set of instructions for using *The Plant Growth Simulator*
3. Worksheets 1-8, which are designed to be used together with the programs
4. Worksheets 9-14, which are designed to be used away from the computer
5. A glossary of all new terms used within the programs

Have the students read the introduction the evening before they begin the program. Have them keep the set of instructions or a photocopy of the page near them while using the program. Require students to keep the appropriate worksheet with them as each program is being viewed. Have them use the remaining worksheets to comply with your own lesson ideas. The worksheets are as follows:

1. Pollination
2. Fertilization and Fruit Formation
3. Spreading Seeds
4. Plant Growth
5. How Plants Respond
6. Growing Plants Without Seeds
7. Parts of the Flower
8. Parts of the Flower
9. Crossword Review—Disk I
10. Crossword Review—Disk II
11. Word Search Puzzle
12. Complete the Paragraph—Disk I
13. Complete the Paragraph—Disk II
14. Creative Writing

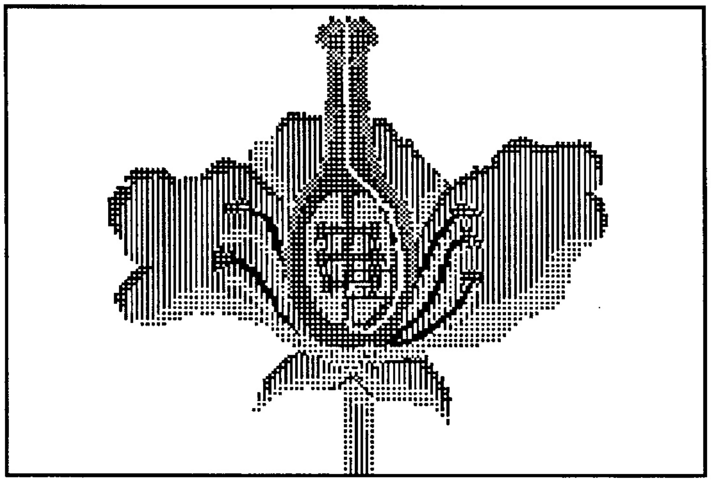
Answer Keys

Worksheet 1

1. stamen
2. pistil
3. wind, water, small animals
4. True
5. Yes
6. It blows from one plant to another.
7. brightly colored petals
8. pollen
9. B
10. False
11. stamen, pistil

Worksheet 2

1. sperm, egg
2. pistil
3. ovary
4. seed
5.



6. They dry up and drop off.
7. seeds

Worksheet 3

1. young plants can grow
2. seedlings
3. sunlight, water
4. the wind
5. parachute
6. 1. sticks to feathers
    2. in their beaks
7. wings
8. True
9. Water
10. C

Worksheet 4

1. seeds, parts of an older plant
2. C
3. True
4. germination
5. 1. moisture
    2. temperature
    3. air in the soil
6. roots
7. cotyledons
8. shrink
9. monocot
10. root
11. stem

Worksheet 5

1. phototropism
2. A
3. thigmotropism
4. True
5. False
6. geotropism
7. False
8. the center of the earth, away from the earth's center
9. hydrotropism
10. roots
11. C

Worksheet 6

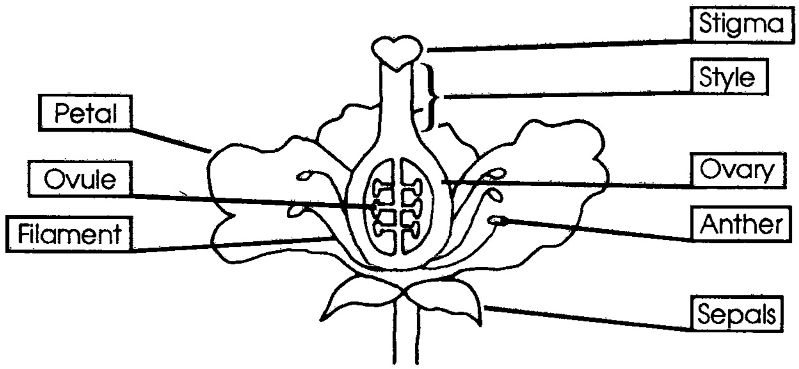
1. root
2. B
3. yes
4. C
5. True
6. yes
7. Food
8. C
9. True
10. False
11. eyes (buds)
12. False

Worksheet 7

1. flower
2. 1. new young plants
   2. food to start growing
3.

Flower Part	Information About The Part
stigma	the sticky top of the pistil
style	the long and thin part of the pistil
ovary	the bottom of the pistil; forms fruit
ovules	form seeds inside the ovary
sepals	leaves that protect a flower before it opens
anther	the flower part that makes pollen
filament	the part that supports the anther
petal	colorful leaves of a flower

Worksheet 8



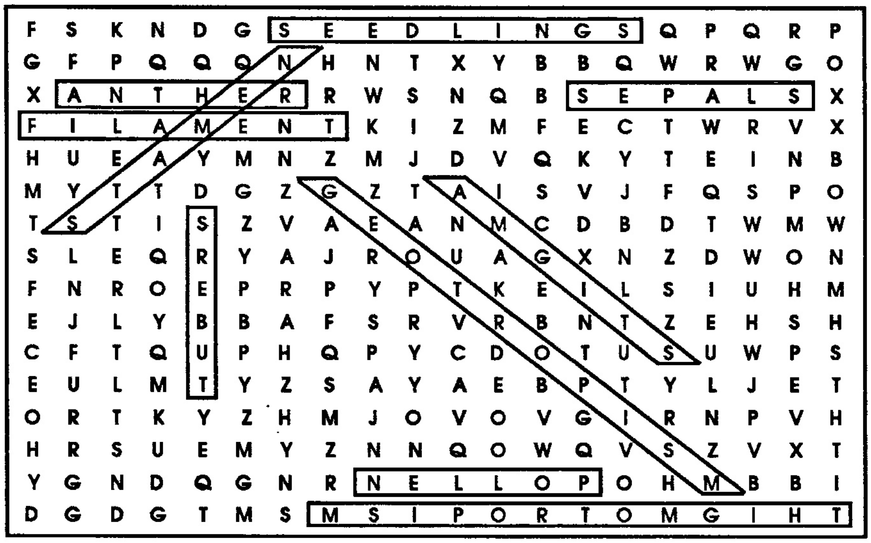
Worksheet 9

							1 C	R	O	S	2 S	
											T	
								3 F			A	
4 B	E	E	5 S			6 S	E	E	D		M	
			E					R			E	
	7 P	O	L	L	I	N	A	T	I	O	N	
	E		F					I				
	T							L				
	A				8 F	R	U	I	T			
	L							Z				
	S					9 O	V	A	R	Y		
								T				
							10 W	I	N	D		
								O				
				11 C	O	C	O	N	U	T		

Worksheet 10

					1 P									
					O					2 G				
		3 B		4 S	T	R	A	W	B	E	R	R	Y	
		E			A					R				
5 G	R	A	V	I	T	Y				M				
		N			O					I				
							6 R	U	N	N	E	R		
										A				
				7 I		8 L		9 M		10 T	U	11 B	E	R
				12 R	H	I	Z	O	M	E		U		
				I		G		N				L		
				S		H		O				B		
						T		13 C	O	R	N			
								O						
				14 D	I	C	O	T						

Worksheet 11



F	S	K	N	D	G	S	E	E	D	L	I	N	G	S	Q	P	Q	R	P
G	F	P	Q	Q	Q	N	H	N	T	X	Y	B	B	Q	W	R	W	G	O
X	A	N	T	H	E	R	R	W	S	N	Q	B	S	E	P	A	L	S	X
F	I	L	A	M	E	N	T	K	I	Z	M	F	E	C	T	W	R	V	X
H	U	E	A	Y	M	N	Z	M	J	D	V	Q	K	Y	T	E	I	N	B
M	Y	T	T	D	G	Z	G	Z	T	A	I	S	V	J	F	Q	S	P	O
T	S	T	I	S	Z	V	A	E	A	N	M	C	D	B	D	T	W	M	W
S	L	E	Q	R	Y	A	J	R	O	U	A	G	X	N	Z	D	W	O	N
F	N	R	O	E	P	R	P	Y	P	T	K	E	I	L	S	I	U	H	M
E	J	L	Y	B	B	A	F	S	R	V	R	B	N	T	Z	E	H	S	H
C	F	T	Q	U	P	H	Q	P	Y	C	D	O	T	U	S	U	W	P	S
E	U	L	M	T	Y	Z	S	A	Y	A	E	B	P	T	Y	L	J	E	T
O	R	T	K	Y	Z	H	M	J	O	V	O	V	G	I	R	N	P	V	H
H	R	S	U	E	M	Y	Z	N	N	Q	O	W	Q	V	S	Z	V	X	T
Y	G	N	D	Q	G	N	R	N	E	L	L	O	P	O	H	M	B	B	I
D	G	D	G	T	M	S	M	S	I	P	O	R	T	O	M	G	I	H	T

Worksheet 12

1. Pollination happens in plants when POLLEN moves from the male part to the female part of a flower. The male part is called the STAMEN and the female part is called the PISTIL. Three things that help pollination are WIND, WATER, and ANIMALS.

2. Fertilization happens when a SPERM (which is the male cell) joins with an EGG (which is the female cell). A tube forms and the sperm moves around the lower and fatter part of the pistil called the OVARY. After the male cell and the female cell join, they begin to form a SEED.

3. Plants spread their seeds so that new plants can grow. The new plants are called SEEDLINGS. The wind helps to spread dandelion seeds. The shape of the top of the seed acts like a PARACHUTE. The maple tree spreads its seeds with a WING-shaped fruit. They make the seed spin away from the tree branch. The COCONUT floats in water until it is carried to a new beach, where a new plant may grow. The TOUCH-ME-NOT plant has a fruit that pops open, letting the seeds burst from its pods.

Worksheet 13

1. The growth of a new plant from a seed is called GERMINATION. Seeds will begin to grow when the MOISTURE, TEMPERATURE, and AIR in the soil are right. The ROOTS begin to grow first. They hold the plant in the soil as the STEM grows up through the ground.

2. Some plants have seeds that form two small leaves. Plants with these two seed leaves are called DICOT plants. Plants with only one seed leaf are called MONOCOT plants. An example of a plant with two seed leaves is the BEAN plant. A plant that has only one seed leaf is the CORN plant.

3. Plants grow toward light. When they do this it is called PHOTOTROPISM. Some plants respond to touch. This is called THIGMOTROPISM. A plant that curls around insects when they land is called the VENUS FLYTRAP. When plants respond to gravity it is called GEOTROPISM. The roots of a plant, for example, grow down, while the stem grows up. When a plant responds to water, it is called HYDROTROPISM. The roots of a plant will grow faster on the side of the plant closest to the water.

4. Many plants grow without seeds. A strawberry plant is an example of a plant that can grow from RUNNERS. An iris grows from thick stems beneath the soil called RHIZOMES. Onions and tulips grow from BULBS. The potato actually forms underground from certain kinds of stems called TUBERS.

Worksheet 14

Responses will vary.

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